Cystic Fibrosis-Related Diabetes (CFRD):
What You Should Know

| Adding tomorrows every day.

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Cystic Fibrosis-Related Diabetes (CFRD): Diagnosis and Screening

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What Is Diabetes?

- There are different types of diabetes, including CF related diabetes (CFRD), but they have the following in common:
  - The body does not make enough insulin (**insulin deficiency**)
    And / Or
  - Insulin does not work well enough in the body (**insulin resistance**)
How Insulin Works: Secreted by the pancreas in response to food, insulin acts as a key that opens the lock on the cell so glucose (sugar) can enter.
Insulin...

- ...helps the body use food to produce energy, gain weight and build muscle.
- ...moves glucose from the blood into the cells where it is used for energy and storage.
- ...moves protein from blood into muscle cells to build muscles.
- ...moves fat from blood into fat cells to store fat.

**INSULIN IS ANABOLIC = BUILDS-UP**
Types of Diabetes

- **Type 1** (formerly insulin dependent or juvenile onset)
  - Makes NO insulin

- **Type 2** (formerly insulin independent or adult onset)
  - Two problems are present:
    - Insulin resistant---need extra insulin
    - Make some insulin but not enough
  - Usually obese, high cholesterol, high blood pressure
Types of Diabetes

- **CF Related Diabetes (CFRD)**
  - Make some insulin but not enough
  - Insulin sensitive unless sick
Why Is Diabetes Common in CF?

• Damage to the pancreas causes scarring (fibrosis), which destroys about half of the insulin-secreting cells: insulin deficiency.

• During infection, steroid use or pregnancy the body needs extra insulin: insulin resistance---someone with CF may not be able to make extra insulin.
Diabetes is **not** caused by something you do or eat…

there is **nothing** you can do to cause or prevent CFRD!
CFRD More Common With Age

Prevalence (%)

Age, years

<10 10-19 20-29 30-39 >40

0 10 20 30 40 50 60
Spectrum of CF Glucose Tolerance

- Normal
- Abnl CGM
- Indeterminate
- IGT
- CFRD FH-
- CFRD FH+
- Type 1

Generally Clinical Stable
Spectrum of CF Glucose Tolerance

- Normal
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Generally Clinical Stable

Increasing Risk
Spectrum of CF Glucose Tolerance

- Normal
- Abnl CGM
- Indeterminate
- IGT
- CFRD FH-
- CFRD FH+
- Type 1

- Generally Clinical Stable
- Increasing Risk
- Highest Risk
What Happens Without Insulin?

• Hyperglycemia (high blood glucose)
  – Fatigue, blurred vision, diminished ability to fight infection
  – Over time, diabetes complications (eye, kidney, nerve)

• The excess glucose in the blood is eliminated in the urine
  – Increased urination, increased thirst
  – Dehydration, viscous secretions
What Happens Without Insulin?

Major Concern with CFRD

• Body protein and fat stores are broken down for energy
  – Weight loss, including muscle
    • Impacts lung function
  – Death if untreated
FEV$_1$ declines more quickly in people with untreated impaired glucose tolerance and diabetes.
Insulin Insufficiency and Undernutrition in CF

• Insulin deficiency leads to protein breakdown and malnutrition in CF, even when blood glucose levels are relatively normal, and thus negatively affects lung function and survival.

• The CFRD therapies study showed that insulin therapy improves nutritional status, even in people with mild insulin deficiency.
Improve Survival in CFRD
How do you know if you have CFRD? What are the symptoms?

• Increased thirst and urination
• Inability to gain weight or maintain weight despite eating and taking enzymes correctly
• Poor growth in children and youth
• Faster than expected decline in lung function

There may be no symptoms!
That is why screening is so important.
Diabetes Screening: Oral Glucose Tolerance Test (OGTT)

- The OGTT, done when the person is clinically stable, is the test of choice.
- Recommended annually for people with CF who don’t have diabetes.
- OGTT screening should begin at age 10 years.
Diabetes Screening in the Hospital

- Diabetes often first shows up when someone is ill.
- Blood glucose levels should be checked before and 2 hours after eating for at least the first 48 hours when hospitalized.
- Insulin may or may not be needed after the illness resolves.
Diabetes Screening at Home

• There are some situations where initial diabetes screening can be done at home:
  – Continuous gastrostomy feedings (G-Tube)
  – Home IV antibiotics
  – High dose glucocorticoids (prednisone)

• Home glucose monitoring devices are not accurate enough to diagnose diabetes.
Diagnosis: Date of Onset

- The date of onset of CFRD is the date when a person is diagnosed with diabetes, even if their blood glucose levels become normal afterwards.
- It is common for high blood glucose levels to come and go early in the course of diabetes, but over time they are high more often.
Advice for People with CF:

• Don’t be afraid of the diagnosis
• Yes, it is a hassle but manageable
• Be sure to get a yearly OGTT
• Ask your CF center about screening every year
• Blood glucose levels checked when ill
• Catching diabetes early and treating it can save your life!
Cystic Fibrosis-Related Diabetes (CFRD): Daily Management

September 20, 2011

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Monitoring CFRD

• If on insulin it is important to test blood glucose levels at least 3 times a day.
• Usually this is done before the meal dose so that you know if you need to add extra insulin to correct for a high blood glucose.
Monitoring CFRD

- Sometimes done 2 hours after a meal to check whether the meal insulin dose is enough.
- Occasionally done in the middle of the night to make sure your glucose isn’t dropping while you are sleeping.
- **Always** should be done after vigorous exercise.
Hemoglobin A1C (HbA1C)

• Blood test used in type 1 and type 2 diabetes
  – An overall measure of diabetes control
  – Helps to predict risk of diabetes eye and kidney disease
• It is not as accurate in CF
• You can look at the changes from month to month in your own HbA1C to tell you if your control is better or needs improvement
Insulin

• Insulin is the treatment of choice for all peoples with CFRD.
• Pills to treat diabetes do not work in CFRD
  – Cannot be recommended over insulin
• There are many different kinds of insulin and ways to deliver it---the best choice is whatever works best for the individual
Principles of Insulin Therapy

- **Basal (background):** We all need some insulin in our bodies all the time
  - Long acting or, with an insulin pump, rapid-acting that gives a low dose all time

- **Meal coverage:** When we eat we need extra insulin for the carbohydrates in food
  - Rapid acting insulin

- **Correction:** When more insulin is needed if the blood glucose is too high
  - Rapid acting insulin
What a Person with CFRD Should Know about Insulin

• The more you test and match your insulin to your food…
  – The better your blood glucose control
  – The better you’ll feel (improved energy and concentration)
  – The better you’ll be to keep up your weight and muscle mass
What a Person with CFRD Should Know about Insulin

• The amount of insulin you need from day to day can change depending on your…
  – Health and
  – Activity
• Blood glucose levels aren’t “good” or “bad”
  – Highs are a sign that something different needs to be done with the insulin dose
  – Don’t get discouraged when things aren’t perfect
Nutrition for CFRD

- The nutrition recommendations for people with CFRD are not the same as for people with type 1 or type 2 diabetes
- Your usual CF diet does not change. You still need to eat a balanced high calorie, high salt, high protein, high fat diet
- Getting to and keeping a healthy body weight remains an important priority
How Food Affects Blood Glucose

• All foods have calories
• Calories come from the nutrients in foods: carbohydrate, protein and fat
• Only carbohydrate-containing foods raise blood glucose
• Protein and fat do not affect blood glucose
Sources of Carbohydrates ("Carbs")

- All **grains** and grain products: breads, rice, cereal, pasta, etc… use whole grains if possible
- **Fruits**: fresh, canned, dried, fruit juice
- **Starchy vegetables**: corn, peas, potatoes, winter squash
- **Milk** and **yogurt**
- **Legumes**: dried peas and beans
- **Desserts**, **sweetened beverages**, **snack foods**
Reading a Food Label for Carbs

- Look at the serving size
- Look at the carbohydrates & the grams of total carbohydrates in one serving
- ½ cup = 13 grams of total carbohydrates

**Nutrition Facts**

<table>
<thead>
<tr>
<th>Serving Size 1/2 cup (90g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servings Per Container 4</td>
</tr>
<tr>
<td>Amount Per Serving</td>
</tr>
<tr>
<td>Calories 100</td>
</tr>
<tr>
<td>Calories from Fat 30</td>
</tr>
<tr>
<td>% Daily Value</td>
</tr>
<tr>
<td>Total Fat 3g</td>
</tr>
<tr>
<td>Saturated Fat 0g</td>
</tr>
<tr>
<td>Trans Fat 0g</td>
</tr>
<tr>
<td>Cholesterol 0mg</td>
</tr>
<tr>
<td>Sodium 300mg</td>
</tr>
<tr>
<td>Total Carbohydrates 13g</td>
</tr>
<tr>
<td>Dietary Fiber 3g</td>
</tr>
<tr>
<td>Sugars 3g</td>
</tr>
<tr>
<td>Protein 3g</td>
</tr>
</tbody>
</table>
Using Carbohydrate “grams” versus “units/choices/exchanges”

- Food labels and general nutrition information will always list carbohydrate in grams
- Diabetes education materials may also use carbohydrate units, choices, exchanges
- 1 carbohydrate unit/choice/exchange = about 12-15 grams total carbohydrate in a food item
Using Insulin with Carb Counting

- Using what is called an “Insulin to carbohydrate ratio” when taking rapid-acting insulin for meals and snacks
  - Novolog®, Humalog®, Apidra®
- Insulin dose is based on the amount of carbohydrates a person is about to eat
- A common dose is 1 unit of insulin/15 grams of carbohydrate
# Meal Example for Insulin and Carb Counting

<table>
<thead>
<tr>
<th>Food</th>
<th>Carbohydrate grams</th>
<th>Carbohydrate Units</th>
<th>Units of Rapid Acting Insulin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 cup whole milk</td>
<td>13 grams carb</td>
<td>1 carb unit</td>
<td></td>
</tr>
<tr>
<td>1 cup dry cereal</td>
<td>28 grams carb</td>
<td>2 Carb units</td>
<td></td>
</tr>
<tr>
<td>1 large banana</td>
<td>27 grams carb</td>
<td>2 Carb units</td>
<td></td>
</tr>
<tr>
<td>2 slices toast</td>
<td>32 grams carb</td>
<td>2 Carb units</td>
<td></td>
</tr>
<tr>
<td>Margarine or butter</td>
<td>0 grams carb</td>
<td>0 carb units</td>
<td></td>
</tr>
<tr>
<td>2 fried eggs</td>
<td>0 grams carb</td>
<td>0 carb units</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL:</strong></td>
<td><strong>100 grams carb</strong></td>
<td><strong>7 carb units</strong></td>
<td><strong>7 units Insulin</strong></td>
</tr>
</tbody>
</table>
# Food Records

<table>
<thead>
<tr>
<th>Time</th>
<th>Diabetes Medication Or Insulin</th>
<th>Blood Sugar Results</th>
<th>Food Intake</th>
<th>Carbohydrate Information</th>
<th>Physical Activity</th>
<th>Other Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type</td>
<td>Amount</td>
<td>Amount</td>
<td>Type of food/ drink</td>
<td>Units</td>
<td>Grams</td>
</tr>
<tr>
<td>Breakfast</td>
<td>Before</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 hrs After</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snack</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lunch</td>
<td>Before</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 hrs After</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snack</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dinner</td>
<td>Before</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 hrs After</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snack</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Low Blood Glucose (Hypoglycemia)

• Caused by…
  – Too much insulin
  – Not enough carbohydrates
  – Drinking alcohol on an empty stomach
  – More exercise than usual
  – Waiting too long to eat after the meal dose of insulin is given
Hypoglycemia Prevention

• Eat extra carbs with or after physical activity
• Do not drink alcoholic beverages without food
• Treat hypoglycemia right away, do not delay
• Never leave home without your meter and a source of carbohydrates
• Too many episodes may require an insulin change
• Test blood glucose before bedtime
Symptoms of Hypoglycemia

- Headache
- Sweating
- Impaired vision
- Dizziness
- Fast heartbeat
- Hunger
- Shaking
- Irritability
- Anxiety
- Weakness/fatigue
Hypoglycemia – Treatment

Test blood glucose if possible:

- If less than 70 mg/dl, eat or drink 15 grams of carbs (simple carbs that do not require enzymes)
- If BG less than 50 mg/dl, eat or drink 30 grams of carbs
- Wait 15 minutes, retest blood glucose
- If still low, eat another 15 grams of carb until BG is above 70 mg/dl
- Need to have a glucagon emergency kit
Alcohol, CFRD and Hypoglycemia

• Limit to 1 drink/day for women, 2 for men
  – 1 drink = 12 oz beer or 5 oz wine or 1.5 oz hard liquor
• Drink alcohol with food
• Don’t take insulin for alcohol carbs
• Wear diabetes ID
• Check blood glucose to see how it affects you
• Check with your doctor to make sure alcohol is safe for you
Exercise and CFRD

- Exercise is a good thing!
- Blood glucose will vary depending on the type, intensity, and length of activity
- Check blood glucose before, during and after starting a new exercise regimen
- Always carry simple carbs to eat before and during activity
- You may also need additional “free” carbs later in day
## Carbs During Exercise

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Duration (minutes)</th>
<th>Carbs</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild-Moderate</td>
<td>Less than 30</td>
<td>May be unnecessary</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>30-60</td>
<td>15 grams</td>
<td>Each hour</td>
</tr>
<tr>
<td>High</td>
<td>60 or more</td>
<td>30-50 grams</td>
<td>Each hour</td>
</tr>
</tbody>
</table>
Advice for People with CF:

- CFRD is just part of CF
- It is a deficiency in something
- It can be managed, like digestive enzymes or vitamins
Cystic Fibrosis-Related Diabetes (CFRD): Illness, Transplant, Pregnancy

September 20, 2011

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Illness, Steroids and Transplant: A Vicious Cycle

- Acute Illness, Steroids
- Insulin Resistance
- Glucose ↑
Illness, Steroids and Transplant: A Vicious Cycle

Acute illness and steroids cause insulin resistance

Acute Illness, Steroids → Insulin Resistance → Glucose ↑
Illness, Steroids and Transplant: A Vicious Cycle

- Acute illness and steroids cause insulin resistance
- This leads to high glucose if the body can't make more insulin

Acute Illness, Steroids

Insulin Resistance

Glucose
Illness, Steroids and Transplant: A Vicious Cycle

- Acute illness and steroids cause insulin resistance
- This leads to high glucose if the body can’t make more insulin
- Glucose is “food” for bacteria and stimulates their growth, adding to infection

Acute Illness, Steroids

Insulin Resistance

↑ Glucose
Illness, Steroids and CFRD

- Both illness and steroids make insulin not work as well and more is needed.
- Some people with CF only need insulin when they are sick or on steroids. Others, who are always on insulin, may need 2-4 times as much.
- Once the illness resolves or the steroids stop, the insulin dose needs to be dropped back down to baseline.
Transplant and CFRD

• Most CF people who need a transplant have diabetes before transplant.

• Almost all CF people who have transplant have diabetes after transplant because:
  – They had it before transplant.
  – They require steroids after transplant so they are more insulin resistant.
  – They require anti-rejection drugs that inhibit the ability of the pancreas to make insulin.
Transplant and CFRD

• GOOD NEWS!
• Diabetes is often easier to manage after transplant because lung disease and nutrition are so much better after transplant.
Pregnancy and CFRD

• If you’re planning to get pregnant, talk with your CF and diabetes doctors and care team
• Blood glucose needs to be in very good control BEFORE getting pregnant to have the best possible outcome for your baby and you
• Will need to check blood glucose before and after meals
Nutrition for Gestational Diabetes

- Do not cut back on calories or carbs
- Meet with your CF or diabetes dietitian right away to review your diet
- Stop drinking sugary drinks and limit juice
- Insulin is necessary if your blood glucose is too high and you have trouble gaining weight
- Use oral supplements if needed to help with weight gain
CFRD Tips for Special Situations:

• Insulin needs change with different situations.
• When you are ill, taking care of diabetes will help you feel better and heal faster.
• During unusual situations, test your blood glucose level frequently - this is the best guide if you need more or less insulin.
• Work closely with your doctors. They can help you adjust your insulin as needed.
• Learn what you need to know to have the confidence to make these changes yourself.
Cystic Fibrosis-Related Diabetes (CFRD): What You Should Know

Carol Brunzell, RD, CDE
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Cystic Fibrosis-Related Diabetes

What is Cystic Fibrosis-Related Diabetes?

Cystic Fibrosis-Related Diabetes (CFRD) is a unique type of diabetes. It is not the same as diabetes in people without CF. The diagnosis and treatment are not exactly the same. CFRD is extremely common in people with CF especially as they get older. CFRD is found in 35 percent of adults aged 20 to 29 and 43 percent for those over 30 years old.

Causes of CFRD

There are two types of diabetes in the non-CF population - Type I diabetes (known as “insulin-dependent diabetes”) and Type II diabetes (known as “non-insulin dependent diabetes”).

CFRD has some features of both types of diabetes. People with CF do not make enough insulin. This is a result of scarring in the
CF Care Guidelines - Nutrition/GI

Because nutrition is so important to a long and high-quality life for people with cystic fibrosis, the CF Foundation has created several care guidelines related to nutritional and GI (gastrointestinal) issues.

On this page:
- Nutrition in Children and Adults
- Pancreatic Enzyme Replacement
- Cystic Fibrosis-Related Diabetes
- Liver Disease
- Pediatric Nutrition

Nutrition in Children and Adults

Good nutrition is very important for people with cystic fibrosis. To help ensure proper nutrition in people with CF, the CF Foundation Subcommittee on Growth and Nutrition combined recent nutritional studies with an analysis of results from the Patient Registry Report to create guidelines on the management of CF nutrition. Recommendations include:

- High-calorie diet, including supplements when needed
- Behavioral intervention to encourage good eating habits in children
- Keeping track of nutritional indicators, such as body mass index
- Appropriate doses of pancreatic enzymes

Care Guidelines
Diabetes mellitus (MEL-ih-tus), or simply, diabetes, is a group of diseases characterized by high blood glucose levels that result from defects in the body’s ability to produce and/or use insulin.

Not sure what that means? This is the place to find out. We’ve covered all the basics here—and you'll find plenty of links to more in-depth information on a variety of topics and issues.
Thank You

- …for watching
- Antoinette Moran and Carol Brunzell
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- Melissa Chin
- Genentech
- The CF Foundation